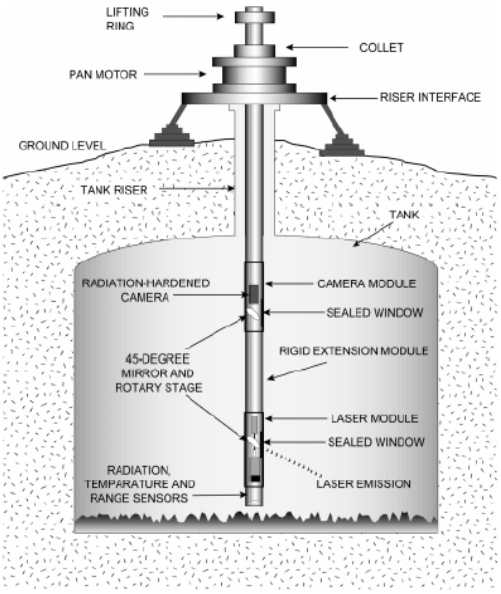
# Topographical Mapping System (TMS)

## *The Challenge*

Hanford's single-shell radioactive waste storage tanks (SSTs) have exceeded their intended design life and the waste must be retrieved and disposed. This task is difficult because the tanks are underground and access is restricted. The SSTs also have high radiation environments and potentially contain flammable gas.




Hardware systems must be deployed to retrieve the waste and provide a clear picture of system performance as retrieval progresses. Operators must discontinue retrieval or switch to an alternate system when the retrieval system effectiveness diminishes. Before the tank can be closed, it must be compliant with a critical Tri-Party Agreement requirement that less than 1% of the waste remains. A remotely operated measurement system will make this quantitative determination.

## *Current Approach*

Tank volumes are currently determined by measuring waste surface height using a contact probe, a manual measuring tape system, or an ENRAF™ buoyancy gauge, with video surveillance. A 4-man crew operates the video surveillance equipment, and an engineer reviews and analyzes the video data to determine volume.

This approach provides a limited single point under riser measurements of surface height and is not adequate to support the critical need for accurate, whole tank waste volumetric assessment needed to justify accelerated retrieval operations.

## *New Technology*

The TMS creates maps of waste topography and tank structures to determine residual tank waste volume. At 3.5 inches in diameter, the laser

### *BENEFITS AND FEATURES*

- Surface mapping techniques measure waste volume to support retrieval and closure of the Hanford SSTs
- Less water used during retrieval reduces risk of potential release to the environment and increases public safety
- Less time to retrieve waste leads to accelerated retrieval schedule

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assembly is small enough to fit through a 4-inch opening, or riser, in the tank. The TMS was installed in Tank U-107, along with a prototype waste retrieval system, by CH2M HILL Hanford Group, Inc. (CHG) in September 2001. After pumping a layer of liquid waste, CHG will begin the effort to remove about 10 percent of the underlying salt cake in Tank U-107. Saltcake waste will be dissolved with water so the dissolved solution can be pumped out of the tank. The key is to use as little water as possible to minimize the risk of a future tank leak.

During the demonstration in Tank U-107, Pacific Northwest National Laboratory (PNNL) operators will make an initial scan of the waste surface. Repeated laser scans of the waste surface will be taken during the retrieval. By alternating small amounts of gentle water sprays with pumping, the TMS will be used to determine which type of sprinkler or configuration of sprinklers works best.

The TMS uses a triangulation-based measurement technique called structured light to generate 3-D maps of the tank environment. A laser plane is projected on the surface to be mapped. The intersection of the laser plane with the waste surface produces a contour that is analyzed and displayed to operators using the Interactive Computer-Enhanced Remote Viewing System. It takes about four hours to scan a 75-foot-diameter Hanford tank. The laser makes an image of the waste surface and displays it on a computer screen for an operator. Computer software calculates the change in tank waste volume based on the "before" and "after" images during the retrieval process.

The TMS may determine more precisely the surface waste volume if line-of-sight to the surface is sufficient. Waste volume under the surface can be inferred based on assumptions about voids, etc. The TMS will also facilitate monitoring changes in the surface contour during retrieval testing, which would allow engineers to better understand the performance of saltcake dissolution systems and thereby select the optimum retrieval system.

The TMS has successfully helped clean up waste sites similar to Hanford, like the series of underground Gunite tanks at Oak Ridge National Laboratory (ORNL). ORNL, PNNL, and Mechanical Technology, Inc. developed the TMS in the early 1990s. The system was developed with Tanks Focus Area Program funds provided by the Department of Energy, Office of Science and Technology.

The TMS will be improved under an FY 2002 Accelerated Site Technology Deployment task. Commercially available video and laser-based range finding and mapping equipment will be combined into an integrated package that meets the requirements for access into the tanks, and provides the requisite reliability, data quality and design robustness. This second generation system is scheduled to be deployed into SST S-112 in the last quarter of FY 2002. Subsequent deployments into two additional SSTs are being planned for S-102 and C-104.

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